Associations of mindful eating domains with depressive symptoms and depression in three European countries

Winkens, L.H.H.; van Strien, T.; Brouwer, I.A.; Penninx, Brenda; Visser, Marjolein; Lähteenmäki, Liisa

published in
Journal of Affective Disorders
2018

DOI (link to publisher)
10.1016/j.jad.2017.11.069

document version
Publisher's PDF, also known as Version of record

citation for published version (APA)
Winkens, L. H. H., van Strien, T., Brouwer, I. A., Penninx, B., Visser, M., & Lähteenmäki, L. (2018). Associations of mindful eating domains with depressive symptoms and depression in three European countries. *Journal of Affective Disorders*, *228*, 26-32. https://doi.org/10.1016/j.jad.2017.11.069

Journal of Affective Disorders 228 (2018) 26–32

Contents lists available at ScienceDirect

Journal of Affective Disorders

journal homepage: www.elsevier.com/locate/jad

Research paper

Associations of mindful eating domains with depressive symptoms and depression in three European countries☆

L.H.H. Winkens[a,*], T. van Strien[a,b], I.A. Brouwer[a], B.W.J.H. Penninx[c], M. Visser[a,d], L. Lähteenmäki[e]

[a] Department of Health Sciences, Faculty of Science, Vrije Universiteit Amsterdam, Amsterdam Public Health research institute The Netherlands
[b] Radboud University Nijmegen, Behavioural Science Institute, Nijmegen, The Netherlands
[c] Department of Psychiatry, VU University Medical Center / GGZ inGeest, Amsterdam, Amsterdam Public Health research institute, The Netherlands
[d] Department of Internal Medicine, Nutrition and Dietetics, VU University Medical Center, Amsterdam, Amsterdam Public Health research institute, The Netherlands
[e] MAPP Centre, Department of Management, Aarhus BSS, Aarhus University, Aarhus, Denmark

ABSTRACT

Objective: To examine associations of mindful eating domains with depressive symptoms and depression in three European countries. Moderation by change in appetite—with increased appetite as marker for depression with atypical features — was also tested.

Methods: Data were collected in Denmark (n = 1522), Spain (n = 1512) and the Netherlands (n = 1439). Multiple linear and logistic regression analyses segregated by country were used to test associations of four mindful eating domains (Mindful Eating Behaviour Scale; MEBS) with depressive symptoms (continuous score on the Center for Epidemiologic Studies Depression Scale; CES-D) and depression (score above the CES-D cut-off value, and/or use of antidepressants, and/or psychological treatment). Moderation by change in appetite was tested with bias-corrected bootstrap confidence intervals.

Results: The domains Focused Eating, Eating with Awareness and Eating without Distraction were significantly negatively associated with depressive symptoms and depression in all three countries (e.g. Focused Eating Denmark: B = − 0.71, 95% CI: − 0.87, − 0.54; OR = 0.89, 95% CI: 0.86, 0.93). The domain Hunger and Satiety Cues (only measured in the Netherlands) was significantly positively associated with depressive symptoms in the adjusted models (B = 0.09, 95% CI: 0.02, 0.16), but not with depression (OR = 1.02, 95% CI: 0.98, 1.05). These associations were found for both people with and without increased appetite.

Limitations: The cross-sectional design, which makes it impossible to draw causal conclusions.

Conclusions: The present study indicates that higher scores on three mindful eating domains are consistently associated with a lower level of depressive symptoms and a lower likelihood of having depression in three European countries.

1. Introduction

Depression is a common illness worldwide, with an estimated 350 million people affected (WHO, 2012). Depression was the fourth leading contributor to the global disease burden in 2002, and it is estimated to be ranked second place in 2030 (Mathers and Loncar, 2006). Prevention of depression is thus a likely candidate to improve public health. There are indications that nutrition and depression are related (Sarris et al., 2015), but research findings are mixed (Quirk et al., 2013). Nutrition is likely to influence the development of depression, but other mechanisms like obesity, the social environment and practices and routines around eating might be involved as well.

Mindful eating is one of the food-related behaviour factors that has been linked with mental well-being (Khan and Zadeh, 2014), and might have an impact on depression. Mindful eating interventions led to a lower level of depressive symptoms (Dalen et al., 2010; Kristeller et al., 2014), but associations in general population samples have not been investigated yet.

Mindful eating may have a direct effect on well-being, because paying attention to what is currently occurring leads to higher quality of experiences to which the attention is paid (Brown and Ryan, 2003; Shapiro et al., 2008). Previous studies found that eating chocolate

☆ The manuscript on the development and psychometric properties of the Mindful Eating Behaviour Scale can be sent on request. Send an email to l.h.h.winkens@vu.nl.

* Correspondence to: Vrije Universiteit Amsterdam, Faculty of Science, Department of Health Sciences, De Boelelaan 1085, 1081 HV Amsterdam, The Netherlands.
E-mail address: l.h.h.winkens@vu.nl (L.H.H. Winkens).

https://doi.org/10.1016/j.jad.2017.11.069
Received 4 August 2017; Received in revised form 13 October 2017; Accepted 12 November 2017
Available online 14 November 2017

mindfully led to an increase in positive mood compared to eating chocolate non-mindfully (Meier et al., 2017) and that mindful eating instructions led to higher enjoyment of previously disliked or avoided foods (Hong et al., 2014).

An indirect effect of mindful eating on well-being can be due to the increased self-awareness that mindful eaters possess. Greater self-awareness may lead to better self-regulation of eating behaviour and this better self-regulation may lead to behaviour changes that increase well-being (Brown and Ryan, 2003; Brown et al., 2007; Heatherton and Baumeister, 1991). Attention to behaviour or subjective experience is important as a first step in making health-enhancing behaviour changes (Safran and Segal, 1996). Mindful attention is related to less mindless impulses towards attractive food and better self-control (Papies et al., 2012). Mindful eating may be important in health-related behavioural changes by disengaging people from automatic behaviour related to eating behaviour (Mantzios and Wilson, 2015).

Two of the many specifiers for depressive disorders in the Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM-5; American Psychiatric Association, 2013) are depression with atypical features and depression with melancholic features, with about 25–30% of patients showing depression with melancholic symptoms and 15–30% of the patients showing depression with atypical symptoms (Gold and Chrousos, 2002). Some of the most important melancholic features are the neurovegetative symptoms loss of appetite and insomnia, whereas the most important atypical features are increased appetite and fatigue (Gold and Chrousos, 2002; Milaneschi et al., 2016; Benazzi, 2002; Angst et al., 2006; Blanco et al., 2011). Depression with atypical features is associated with female gender, the metabolic syndrome (Lamers et al., 2010), a higher body mass index (Lamers et al., 2010; Chou and Yu, 2013; Levitan et al., 2012; Cizza et al., 2012; Lasserre et al., 2014), and a lower diet quality (Rahe et al., 2015). Mindful eating might be especially important for the mental well-being of people with this atypical specifier, because those people show an increase in appetite which is associated with overweight and disordered eating behaviours.

The first aim of this study was to test associations of the mindful eating domains with depressive symptoms and depression in three European countries: Denmark, Spain and the Netherlands. Because consideration of the depression with atypical features specifier may clarify the mindful eating-depression link even further, the second aim was to asses if change in appetite—with increased appetite as a marker for depression with atypical features—acted as a moderator in the associations between the mindful eating domains and depressive symptoms/depression. It was expected that mindful eating and depressive symptoms were negatively associated in all three samples and that this association was stronger for people with increased appetite. Confirmation of these results could give an indication that mindful eating behaviours are involved in depression.

2. Methods

Data were collected in three different countries as part of the MooDFOOD project (Cabout et al., 2017). The study procedure and measures were the same in Denmark and Spain, so they are described simultaneously. The procedure of the data collection in the Netherlands is described separately. Differences in measurements between the samples are discussed per variable.

2.1. Participants and procedure

2.1.1. Denmark and Spain

The data collection in Denmark and Spain was carried out by Qualtrics, a panel service agency, in June and July 2014. The panel service agency invited a randomly selected representative sample of their panelists to fill out an online questionnaire. Qualtrics follows the ESOMAR principles in their data collection activities and panel management: respondents have to confirm their willingness to take part in the study and their data are handled with anonymity and confidentiality in accordance with the provisions of the Declaration of Helsinki.

2.1.2. The Netherlands

Data in the Netherlands were collected within the Longitudinal Aging Study Amsterdam (LASA). LASA is an ongoing cohort study in a representative sample of Dutch older adults aged 55 years and over, which started in 1992. The sampling and data collection procedures have been described in detail elsewhere (Hoogendijk et al., 2016; Huisman et al., 2011). The data used in this study come largely from the 'LASA Nutrition and Food-related Behaviour study' that was conducted in between the fall of 2014 and the spring of 2015 (for details, see Winkens et al., unpublished results). Ethical approval for the LASA study and the side study was given by the Medical Ethics Committee of the VU University Medical Center Amsterdam and all participants provided written informed consent.

2.2. Measures

2.2.1. Depressive symptoms and depression

The Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977) was used to measure depressive symptoms during the past week. The scale has 20 items with a 4-point scale ranging from 0 (rarely or none of the time; less than one day per week) to 3 (most or almost all the time; 5–7 days per week). A higher score indicates a higher level of depressive symptoms. Cronbach's alpha of the CES-D-20 in Denmark, Spain, and the Netherlands were, respectively, 0.89, 0.91, and 0.83.

In the analyses with increased appetite as moderator and depressive symptoms as outcome variable, the item 'I did not feel like eating; my appetite was poor' was deleted from the CES-D scale, which resulted in a CES-D-19 score. The reason is that the CES-D may be biased towards measuring depression with melancholic features, because it does not contain an item on increased appetite.

Depression was defined as: having a clinically relevant level of depressive symptoms (scoring above the CES-D-20 cut-off value: 16 for the Danish and Dutch sample and 24 for the Spanish sample), and/or current use of antidepressants, and/or current psychological treatment. A score of 16 is generally used as a cut-off value to identify subjects with clinically relevant levels of depressive symptomatology (e.g. Boyd et al., 1982). The cut-off score of 24 for the Spanish sample was based on the cut-off value that was found in a validation study by Ruiz-Grosso et al. (2012).

2.2.2. Change in appetite

Change in appetite was examined as potential moderating variable. It was measured with one question derived from the Beck Depression Inventory-II (BDI-II; Beck et al., 1996): 'Did you experience any change in appetite in the past … weeks?'. In Denmark and Spain, the time frame was the past two weeks, while in the Netherlands the past four weeks was used. If people experienced a change, they were additionally asked if they experienced (1) 'little less appetite than usual', (2) 'much less appetite than usual', (3) 'a little more appetite than usual', (4) 'much more appetite than usual', (5) 'no appetite at all' or (6) 'a continuous desire for food'. Answers were categorized into 'increased appetite' (options 3, 4, and 6) and 'no change in appetite/less appetite' (options 1, 2, and 5).

2.2.3. Mindful eating

The Mindful Eating Behaviour Scale (MEBS; Winkens et al., unpublished results) was used to measure the levels of four different domains of mindful eating. Higher scores indicate a higher level of mindful eating. In the Dutch sample, four domains were measured: Focused Eating (5 items, e.g. 'I notice how my food looks'); Eating with

Awareness (3 items, e.g. 'I eat something without being really aware of it', reversed item); Eating without Distraction (4 items, e.g. 'I multi-task when I am eating', reversed item); and Hunger and Satiety Cues (5 items, e.g. 'I trust my body to tell me when to eat'). Answer options ranged from 1 to 5 (never – seldom – sometimes – often – very often). In the Danish and Spanish sample only three out of the four domains of the MEBS were measured (Focused Eating, Eating with Awareness, Eating without Distraction). Answer options ranged from 1 to 4 (never – rarely – sometimes – usually). Cronbach's alpha of the mindful eating domains for Denmark, Spain, and the Netherlands were respectively: 0.88, 0.88, 0.84 for Focused Eating, 0.92, 0.92, 0.81 for Eating with Awareness, 0.70, 0.67, 0.70 for Eating without distraction, and 0.89 for Hunger and Satiety Cues (only measured in the Netherlands).

2.2.4. Confounders

Confounders were sex, age, educational level, alcohol consumption, smoking status, physical activity level and Body Mass Index.

Sex and age were derived from the municipal registries in the Netherlands and were self-reported in Denmark and Spain.

Educational level was self-reported and categorized into low, medium and high in all three countries. In Denmark and Spain, low consisted of 'none, elementary school, junior secondary education till age 15/16', medium of 'upper secondary education, lower and intermediate vocational training' and high of 'higher vocational training, college and university education'. In the Netherlands, low consisted of 'none, elementary school', medium of 'secondary education, lower and intermediate vocational training' and high of 'higher vocational training, college and university education'.

Alcohol consumption was assessed by asking respondents about the number of days per week they drank alcohol and the number of alcoholic drinks on these days (Beukers et al., 2015). In Denmark and Spain the number of alcoholic drinks per day was calculated. In the Netherlands, separate questions were asked for weekdays (Monday-Thursday) and weekend days (Friday-Sunday), and amount of glasses was asked separately for each type of alcoholic drinks (wine, beer etc.). This information was then linked to a nutrient database (based on the Dutch Food Composition Table; NEVO, 2011) to calculate gram ethanol per day.

Smoking status (never-former-current) was self-reported.

Physical activity in Denmark/Spain was measured as frequency of vigorous physical activity for at least 20 min per week in the past four weeks. Vigorous physical activity was defined as 'increases your heart rate, causes you to breathe rapidly and makes a conversation difficult'. Response categories ranged from 1 (less than once a week or never) to 7 (every day during an average week). Physical activity in the Dutch sample was measured using the validated LASA Physical Activity Questionnaire (LAPAQ; Stel et al., 2004). Frequency and duration of walking outdoors, bicycling, light and heavy household activities and sports in the past two weeks were asked. Total time in minutes per day spent on these activities was calculated.

Body Mass Index (BMI) in Denmark/Spain was calculated by dividing self-reported weight by self-reported height in squared meters (kg/m^2). In the Netherlands, measured height and weight were used to calculate BMI in kg/m^2. Weight was measured to the nearest 0.1 kg using a calibrated bathroom scale (Seca, model 100, Lameris, Utrecht, The Netherlands). Height was measured to the nearest 0.001 m using a stadiometer. Corrections have been made to adjust the measured body weight for clothing, shoes or a corset (minus 1 kg for one of those elements and minus 2 kg for more than one). Corrections have been made to adjust the measured height for shoes (minus 1 cm). Mean weight was calculated from measured weight at the waves before (2011–2013) and after (2015–2016) the 'LASA Nutrition and Food-related Behaviour study'. When measured weight from only one of these waves was available, this weight was used. Measured height from 2015 to 2016 was used; when missing, height from 2011 to 2013 was used.

In the Netherlands, sex, age, and educational level were collected at the baseline measurement of LASA. Alcohol consumption was measured in the Nutrition and Food-related Behaviour study. Smoking status and physical activity level had to be derived from the last LASA cycle conducted before the Nutrition and Food-related Behaviour Study (time lag is between 1 and 3.5 years).

2.2.5. Statistical analysis

All analyses were conducted using SPSS 23 (IBM Corporation, 2015) and were segregated by country (Denmark, Spain, the Netherlands). Respondents with one or more missing values on one of the used variables were excluded from the corresponding analyses. People with a current use of antidepressants or current treatment of depression at the time of measurement were excluded from the analyses with depressive symptoms as outcome because of possible distortion of the CES-D scores. In the Dutch sample, respondents who did not fill out the questionnaire themselves were excluded as well.

Descriptive statistics were computed to present the characteristics of the samples.

For the first aim, associations between mindful eating and depressive symptoms were tested using multiple linear regression analyses and associations between mindful eating and depression were tested using multiple logistic regression analyses. Regression analyses were performed with the four mindful eating domains separately as independent variables. Unstandardized beta's (B) or odd ratios (OR), and 95% confidence intervals (CI) were reported. Results were considered statistically significant when $p < 0.05$.

For the second aim, moderation of increased appetite versus decreased appetite/no change in appetite in both the mindful eating – depressive symptoms (CES-D-19) link and the mindful eating-depression link was tested using the Process macro of Hayes (Hayes, 2013). This was done only in the Danish and Spanish sample because the number of people with increased appetite in the Dutch sample was too low. Bootstrapping with 5000 samples was used. Unstandardized beta's were reported. Results were considered statistically significant when the bias-corrected bootstrap 90% CI did not contain zero.

Analyses were adjusted for age, sex, educational level, alcohol consumption, smoking status and physical activity level (adjusted model 1) and additionally for BMI (adjusted model 2).

3. Results

3.1. Analytical samples

In Denmark 1522 people participated. People with outlying values (± 3 standard deviations) on height or weight ($n = 47$) or with missing values on confounding variables ($n = 3$) were excluded. This resulted in an analytical sample of 1472 persons for the analyses with depression. For the analyses with depressive symptoms, people with a current use of antidepressants or current psychological treatment at the time of measurement or a missing on this variable ($n = 151$) were excluded as well. This resulted in an analytical subsample of 1321 persons for the analyses with depressive symptoms. People with no or incomplete data on the question on change in appetite ($n = 21$) were additionally excluded from the moderation analyses.

In Spain 1512 people participated. People with outlying values (± 3 standard deviations) on height or weight ($n = 23$) or with missing values on confounding variables ($n = 1$) were excluded. This resulted in an analytical sample of 1488 persons for the analyses with depression. For the analyses with depressive symptoms, people with a current use of antidepressants or current psychological treatment at the time of measurement or a missing on this variable ($n = 112$) were excluded as

Table 1
Characteristics of total samples from Denmark, Spain and the Netherlands.

	Denmark	Spain	the Netherlands
n	1472	1488	1115
Age (years)	50.1 [16.4]	36.9 [11.3]	68.6 [7.9]
Sex (% female)	47.7 (692)	48.7 (719)	51.6 (575)
Education (%)			
Low	24.1 (350)	10.9 (161)	11.2 (125)
Medium	40.7 (590)	34.5 (509)	56.8 (633)
High	35.2 (511)	54.6 (807)	32.0 (357)
Physical activity (PA)			
Days per week intensive PA	3.0 [2.3]	3.1 [2.3]	–
Minutes per day	–	–	158.0 [107.2]
Alcohol use			
Glasses per day	0.9 [1.4]	0.6 [1.0]	–
Gram ethanol per day	–	–	14.7 [17.2]
Smoking (%)			
Never	40.9 (593)	45.0 (665)	27.5 (307)
Former	35.2 (511)	23.8 (351)	60.5 (675)
Current	23.9 (347)	31.2 (461)	11.9 (133)
Body Mass Index (kg/m^2)	26.2 [5.0]	24.7 [4.4]	27.0 [4.3]

Note: Values are mean [standard deviation] or % (*n*).

well. This resulted in an analytical subsample of 1376 persons for the analyses with depressive symptoms. People with no or incomplete data on the question on change in appetite ($n = 11$) were additionally excluded from the moderation analyses.

In the Netherlands, persons participating in the 'LASA Nutrition and Food-related Behaviour study' were selected ($N = 1439$) for this study. People that did not fill out the questionnaire for themselves ($n = 125$) or with no or incomplete data on the Mindful Eating Behaviour Scale (MEBS; Winkens, 2017) ($n = 55$), the Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1997) ($n = 48$), or confounding variables ($n = 96$) were excluded. This resulted in an analytical sample of 1115 persons for the analyses with depression. For the analyses with depressive symptoms, people with a current use of antidepressants and/or current psychological treatment at the time of measurement ($n = 72$) were excluded as well. This resulted in an analytical sample of 1043 persons for depressive symptoms.

Characteristics of the total samples are described in Table 1. In Table 2 means and standard deviations of the dependent and independent variables are shown for the total samples and the subsamples.

3.2. Mindful eating and depressive symptoms

Results of the multiple linear regression analyses of the mindful eating domains on depressive symptoms are shown in Table 3. Higher scores on the domains Focused Eating, Eating with Awareness and Eating without Distraction were significantly associated with a lower level of depressive symptoms in all three samples; e.g. a one point increase in Focused Eating in the Danish sample led to a decrease of 0.71 point in the depressive symptoms score in the fully adjusted model. A higher score on the domain Hunger and Satiety Cues (only measured in the Dutch sample) was significantly associated with a higher level of depressive symptoms; a one point increase in Hunger and Satiety Cues in the Dutch sample led to a 0.09 point increase in the depressive symptoms score in the fully adjusted model.

3.3. Mindful eating and depression

Results of the multiple logistic regression analyses of the mindful eating domains on depression are shown in Table 4. The domains Focused Eating, Eating with Awareness and Eating without Distraction were all significantly negatively associated with depression in all three samples; e.g., a one point increase in Focused Eating in the Danish sample reduced the odds of being depressed by 11% in the fully adjusted model. The domain Hunger and Satiety Cues was not significantly associated with depression in the Dutch sample in the fully adjusted model.

3.4. Moderation by change in appetite

Change in appetite was only a moderator in the association between Eating with Awareness and depressive symptoms in the Danish sample (B = − 0.77, 90% CI: − 1.45, − 0.09); the association between Eating with Awareness and depressive symptoms was significant in both the increased appetite and decreased/not changed appetite groups, but this association was stronger for the increased appetite group, respectively B = − 1.82 (90% CI: − 2.47, − 1.17), and B = − 1.05 (90% CI: − 1.26, − 0.85) in the fully adjusted models.

4. Discussion

This study was the first to investigate associations of mindful eating with depressive symptoms and depression. Higher scores on the mindful eating domains Focused Eating, Eating with Awareness, and

Table 2
Scores on mindful eating domains, depressive symptoms, depression and increased appetite in total samples and in samples of people without current antidepressant use and/or current treatment of depression from Denmark, Spain and the Netherlands.

	Denmark		Spain		The Netherlands	
	Total sample	Subsample	Total sample	Subsample	Total sample	Subsample
n	1472	1321	1488	1376	1115	1043
Focused Eating[a]	17.3 [3.1]	17.3 [3.1]	16.3 [3.3]	16.3 [3.3]	20.1 [3.3]	20.1 [3.3]
Eating with Awareness[b]	10.5 [2.2]	10.6 [2.1]	9.9 [2.5]	9.9 [2.4]	12.9 [2.1]	12.9 [2.1]
Eating without Distraction[c]	10.9 [2.7]	10.9 [2.6]	10.7 [2.4]	10.8 [2.4]	15.4 [2.7]	15.5 [2.7]
Hunger and Satiety Cues[d]	–	–	–	–	15.4 [5.2]	15.4 [5.2]
Depressive symptoms, score	12.8 [10.6]	11.7 [9.6]	15.5 [11.1]	14.6 [10.5]	9.1 [6.5]	8.7 [6.1]
Depression, %	29.0 (427)	25.2 (333)	25.7 (382)	22.8 (314)	15.1 (168)	13.2 (38)
Increased appetite[e],%	5.4 (79)	4.8 (63)	16.7 (249)	15.8 (218)	0.7 (8)	0.7 (7)

Note: Values are mean [standard deviation] or % (*n*).
The subsamples are the samples of people without current use of antidepressants or current psychological treatment. Depressive symptoms = Center for Epidemiologic Studies Depression Scale (CES-D) continuous score; Depression = score above CES-D cut-off value (≥ 16 Danish and Dutch sample; ≥ 24 Spanish sample).

[a] Scores can range from 5 to 20 in Denmark and Spain, and from 5 to 25 in the Netherlands.
[b] Scores can range from 3 to 12 in Denmark and Spain, and from 3 to 15 in the Netherlands.
[c] Scores can range from 4 to 16 in Denmark and Spain, and from 4 to 20 in the Netherlands.
[d] Scores can range from 5 to 25 in the Netherlands.
[e] Increased appetite = marker for depression with atypical features; *n* differs due to missing values on change in appetite: Denmark: $n = 1451$ and $n = 1301$; Spain: $n = 1477$ and $n = 1365$; the Netherlands: $n = 1112$ and $n = 1040$.

Table 3
Crude and adjusted linear regression analyses of the associations of mindful eating domains with depressive symptoms in samples of people without current antidepressant use and/or current treatment of depression from Denmark, Spain and the Netherlands.

	Denmark (n = 1321)		Spain (n = 1376)		the Netherlands (n = 1043)	
	B	95% CI	B	95% CI	B	95% CI
Focused Eating						
Crude	− 0.93**	− 1.09; − 0.77	− 0.81**	− 0.98; − 0.65	− 0.47**	− 0.58; − 0.36
Adjusted[a]	− 0.70**	− 0.87; − 0.54	− 0.73**	− 0.90; − 0.57	− 0.43**	− 0.54; − 0.33
Adjusted[b]	− 0.71**	− 0.87; − 0.54	− 0.74**	− 0.90; − 0.57	− 0.42**	− 0.53; − 0.32
Eating with Awareness						
Crude	− 1.62**	− 1.85; − 1.39	− 1.72**	− 1.92; − 1.51	− 0.73**	− 0.90; − 0.56
Adjusted[a]	− 1.28**	− 1.15; − 1.04	− 1.60**	− 1.81; − 1.39	− 0.75**	− 0.91; − 0.58
Adjusted[b]	− 1.27**	− 1.51; − 1.03	− 1.59**	− 1.81; − 1.39	− 0.73**	− 0.89; − 0.56
Eating without Distraction						
Crude	− 0.89**	− 1.08; − 0.70	− 1.19**	− 1.41; − 0.97	− 0.60**	− 0.73; − 0.47
Adjusted[a]	− 0.72**	− 0.91; − 0.53	− 1.11**	− 1.33; − 0.89	− 0.64**	− 0.77; − 0.51
Adjusted[b]	− 0.72**	− 0.91; − 0.53	− 1.09**	− 1.33; − 0.89	− 0.63**	− 0.76; − 0.51
Hunger and Satiety Cues						
Crude	–	–	–	–	0.05	− 0.02; 0.12
Adjusted[a]	–	–	–	–	0.07*	0.004; 0.14
Adjusted[b]					0.09*	0.02; 0.16

Notes: Depressive symptoms = Center for Epidemiologic Studies Depression Scale (CES-D) continuous score; B = unstandardized regression coefficients; CI = confidence interval.
[a] Adjusted for sex, age, educational level, alcohol consumption, smoking status, physical activity level.
[b] Additionally adjusted for Body Mass Index.
* $p < 0.05$.
** $p < 0.001$.

Table 4
Crude and adjusted logistic regression analyses of associations of mindful eating domains with depression in samples of Denmark, Spain and the Netherlands.

	Denmark (n = 1472)		Spain (n = 1488)		the Netherlands (n = 1115)	
	OR	95% CI	OR	95% CI	OR	95% CI
Focused Eating						
Crude	0.86**	0.83; 0.89	0.87**	0.84; 0.90	0.91**	0.87; 0.95
Adjusted[a]	0.90**	0.86; 0.93	0.87**	0.84; 0.90	0.92**	0.88; 0.96
Adjusted[b]	0.89**	0.86; 0.93	0.88**	0.84; 0.91	0.92**	0.88; 0.97
Eating with Awareness						
Crude	0.76**	0.72; 0.80	0.74**	0.70; 0.77	0.85**	0.80; 0.91
Adjusted[a]	0.80**	0.76; 0.85	0.75**	0.71; 0.79	0.84**	0.79; 0.90
Adjusted[b]	0.81**	0.76; 0.85	0.75**	0.72; 0.79	0.85**	0.79; 0.92
Eating without Distraction						
Crude	0.85**	0.81; 0.88	0.81**	0.77; 0.85	0.84**	0.80; 0.89
Adjusted[a]	0.87**	0.83; 0.91	0.82**	0.78; 0.86	0.84**	0.79; 0.89
Adjusted[b]	0.87**	0.83; 0.91	0.82**	0.78; 0.86	0.84**	0.79; 0.89
Hunger and Satiety Cues						
Crude	–	–	–	–	1.00	0.98; 1.03
Adjusted[a]	–	–	–	–	1.01	0.98; 1.04
Adjusted[b]	–	–	–	–	1.02	0.98; 1.05

Notes: Depression = score above CES-D cut-off score (≥ 16 Danish and Dutch sample; ≥ 24 Spanish sample), and/or current use of antidepressants, and/or current psychological treatment; OR = odds ratio; CI = confidence interval.
[a] Adjusted for sex, age, educational level, alcohol consumption, smoking status, physical activity level.
[b] Additionally adjusted for Body Mass Index.
** $p < 0.001$.

Eating without Distraction were associated with a lower level of depressive symptoms and a lower likelihood of having depression in the Danish, Spanish and Dutch samples. In contrast to expectations, a *lower* score on the mindful eating domain Hunger and Satiety Cues, which was only measured in the Dutch sample, was significantly associated with a lower level of depressive symptoms. Hunger and Satiety Cues was furthermore not associated with depression. Increased appetite—as a marker for depression with atypical features—only modified the association between Eating with Awareness and depressive symptoms in one of the samples (Denmark); this association was somewhat stronger in the group of people with increased appetite, but still significant in the group with no change/decreased appetite.

Previous studies have found that mindful eating interventions lead to a lower level of depressive symptoms (Dalen et al., 2010; Kristeller et al., 2014), but the responsible mechanisms for this change have not been studied and both of these studies were done in people with overweight or obesity. Experimental studies showed that mindful eating led to increased positive mood after the consumption of chocolate (Meier et al., 2017) and to higher enjoyment of food (Hong et al., 2014), but this was only studied in student samples. This study adds to the evidence that mindful eating plays a role in mental well-being, also outside of the food domain, by consistently showing associations between three mindful eating domains and depression in three samples representing populations in general or from certain age groups.

The domain Hunger and Satiety Cues was positively associated with depressive symptoms in the adjusted models. An explanation might be that a higher score on this domain might imply a heightened sensitivity to all inner cues, also to negative feelings. However, in the study by

Tylka and Kroon Van Diest (2013), Hunger and Satiety Cues was negatively associated with negative affect. An explanation of this contradictory finding and the non-significant association between Hunger and Satiety Cues and depression may be the older sample of people aged 55 years and above in this study. Hunger, satiety and appetite change with the aging process, due to physiological and psychological alterations, and anorexia of aging might occur (Elsner, 2002; Morley, 2012, 2013). Also, interoceptive awareness, the ability to sense bodily cues, declines with age (Khalsa et al., 2009). The association between Hunger and Satiety Cues and depression should therefore be further investigated in younger samples as well.

Changes in appetite were taken into account in this study because they may be used as markers for depression with atypical or melancholic features and consideration of these may provide greater insight into the mindful eating-depression link. Increased appetite, the neurovegetative symptom of depression with atypical features, was only found to modify the Eating with Awareness-depressive symptoms link in Denmark: the association between Eating with Awareness and depressive symptoms was somewhat stronger for people with increased appetite, but the association was still significant for the people without an increase in appetite as well. This suggests that mindful eating is related to depression in both groups of people with increased appetite and no change/decreased appetite. It might be that change in appetite had no influence on the associations between mindful eating and depression in the Spanish sample, because atypical depression might be typical for countries with a higher northern latitude (see van Strien et al., 2016). The high percentage of people with increased appetite in Spain (16.7%) might be explained by reasons different from depression with atypical features.

In the Dutch sample, the number of people with increased appetite was too low to conduct analyses with this variable. The percentage of people with increased appetite was considerably lower than we expected to find: only 0.7%. Other studies found a higher percentage of people with atypical depression, mostly around 5% in non-clinical populations (Lasserre et al., 2014; Rahe et al., 2015). In a sample of 2981 Dutch people aged 18–65 years of the Netherlands Study of Depression and Anxiety (NESDA; Penninx et al., 2008), 24.6% displayed atypical features (Lamers et al., 2010), and 16% of depressed Dutch people had levels of increased appetite (ten Have et al., 2016). This low percentage in the Dutch sample might be caused by the method that we used to classify people, together with changes in appetite that may have occurred due to the older age of this sample, as mentioned before. Although there seems enough evidence for using the neurovegetative symptom increased appetite to distinguish the subtypes of depression (Milaneschi et al., 2016; Blanco et al., 2011; Ohayon and Roberts, 2015), other classification methods might be more useful in older samples.

A strength of this study is the use of large sample sizes of three European countries with different age groups and characteristics. Another strength was that next to depressive symptoms, also depression and increased appetite—as a marker for depression with atypical features—were taken into account. A final strength is the use of the MEBS as it was developed to overcome some limitations of earlier questionnaires Winkens et al., unpublished results). This scale also makes it possible to test different domains of mindful eating in relation to depression. However, the MEBS has not been validated in the Danish and Spanish population.

A limitation of this study is the cross-sectional design, which makes it impossible to draw causal conclusions. We cannot rule out the possibility that depression precedes mindful eating. However, previous studies showed that mindfulness-based interventions focused on eating behaviour led to an improvement in depressive symptoms (Dalen et al., 2010; Kristeller et al., 2014), which suggests that our hypothesized direction is plausible. Research into these causal directions is needed, by increasing mindful eating through interventions and study the effects on depressive symptoms. Previous studies made for example use of audio recordings (e.g. Meier et al., 2017; Hong et al., 2014) or concrete construal diaries (Mantzios and Wilson, 2014; Hussein et al., 2017) to enhance mindfulness. In further research, perhaps the same procedures could also be practiced for increasing mindfulness in the specific domain of eating.'

In conclusion, the present study indicates that higher levels of the mindful eating domains Focused Eating, Eating with Awareness and Eating without Distraction are consistently associated with a lower level of depressive symptoms and a lower likelihood of having depression in three European countries. Future studies should investigate possible mechanisms that might explain these associations. Because this study shows that different domains of mindful eating might be involved in mental well-being, studies investigating causal associations and underlying mechanisms could give insight into the specific implications of these different domains.

Acknowledgements

Funding for this paper was provided by the European Union FP7 MooDFOOD Project 'Multi-country cOllaborative project on the rOle of Diet, FOod-related behaviour, and Obesity in the prevention of Depression' [grant agreement no. 613598].

The Longitudinal Aging Study Amsterdam is supported by a grant from the Netherlands Ministry of Health Welfare and Sports, Directorate of Long-Term Care (321175 and 325889). The data collection in 2012-2013 was financially supported by the Netherlands Organization for Scientific Research (NWO) in the framework of the project "New Cohorts of young old in the 21st century" [file number 480-10-014].

References

American Psychiatric Association, 2013. Diagnostic and Statistical Manual of Mental Disorders, 5th ed. American Psychiatric Publishing, Arlington, VA.

Angst, J., Gamma, A., Benazzi, F., Silverstein, B., Ajdacic–Gross, V., Eich, D., Rössler, W., 2006. Atypical depressive syndromes in varying definitions. Eur. Arch. Psychiatry Clin. Neurosci. 256 (1), 44–54.

Beck, A.T., Steer, R.A., Brown, G.K., 1996. Beck Depression Inventory-II. Psychological Corporation, TX: San Antonio.

Benazzi, F., 2002. Can only reversed vegetative symptoms define atypical depression? Eur. Arch. Psychiatry Clin. Neurosci. 252 (6), 288–293.

Beukers, M.H., Dekker, L.H., de Boer, E.J., Perenboom, C.W.M., Meijboom, S., Nicolaou, M., de Vries, J.H.M., Brants, H.A.M., 2015. Development of the HELIUS food frequency questionnaires: ethnic-specific questionnaires to assess the diet of a multiethnic population in the Netherlands. Eur. J. Clin. Nutr. 69 (5), 579–584.

Blanco, C., Vesga-López, O., Stewart, J.W., Liu, S.M., Grant, B.F., Hasin, D.S., 2011. Epidemiology of major depression with atypical features: results from the National Epidemiologic Survey on alcohol and related conditions (NESARC). J. Clin. Psychiatry 73 (2), 224–232.

Boyd, J.H., Weissman, M.M., Thompson, W.D., Myers, J.K., 1982. Screening for depression in a community sample: understanding the discrepancies between depression symptom and diagnostic scales. Arch. Gen. Psychiatry 39 (10), 1195–1200.

Brown, K.W., Ryan, R.M., 2003. The benefits of being present: mindfulness and its role in psychological well-being. J. Pers. Soc. Psychol. 84 (4), 822.

Brown, K.W., Ryan, R.M., Creswell, J.D., 2007. Mindfulness: theoretical foundations and evidence for its salutary effects. Psychol. Inq. 18 (4), 211–237.

Cabout, M., Brouwer, I.A., Visser, M., 2017. The MooDFOOD project: prevention of depression through nutritional strategies. Nutr. Bull. 42 (1), 94–103.

Chou, K.L., Yu, K.M., 2013. Atypical depressive symptoms and obesity in a national sample of older adults with major depressive disorder. Depress. Anxiety 30 (6), 574–579.

Cizza, G., Ronsaville, D.S., Kleitz, H., Eskandari, F., Mistry, S., Torvik, S., Sonbolian, N., Reynolds, J.C., Blackman, M.R., Gold, P., Martinez, P.E., 2012. Clinical subtypes of depression are associated with specific metabolic parameters and circadian endocrine profiles in women: the power study. PLoS One 7 (1), e28912.

Dalen, J., Smith, B.W., Shelley, B.M., Sloan, A.L., Leahigh, L., Begay, D., 2010. Pilot study: mindful Eating and Living (MEAL): weight, eating behavior, and psychological outcomes associated with a mindfulness-based intervention for people with obesity. Complement Ther. Med. 18 (6), 260–264.

Elsner, R.J., 2002. Changes in eating behavior during the aging process. Eat. Behav. 3 (1), 15–43.

Gold, P.W., Chrousos, G.P., 2002. Organization of the stress system and its dysregulation in melancholic and atypical depression: high vs low CRH/NE states. Mol. Psychiatry 7 (3), 254–275. http://dx.doi.org/10.1038/sj.mp.4001032.

ten Have, M., Lamers, F., Wardenaar, K., Beekman, A., de Jonge, P., van Dorsselaer, S., Tuithof, M., Kleinjan, M., de Graaf, R., 2016. The identification of symptom-based

subtypes of depression: a nationally representative cohort study. J. Affect. Disord. 190, 395–406. http://dx.doi.org/10.1016/j.jad.2015.10.040.
Hayes, A.F., 2013. Introduction to Mediation, Moderation, and Conditional Process Analysis: a Regression-based Approach. Guilford Press, New York.
Heatherton, T.F., Baumeister, R.F., 1991. Binge eating as escape from self-awareness. Psychol. Bull. 110 (1), 86–108.
Hong, P., Lishner, D.A., Han, K.H., 2014. Mindfulness and eating: an experiment examining the effect of mindful raisin eating on the enjoyment of sampled food. Mindfulness 5 (1), 80–87.
Hoogendijk, E.O., Deeg, D.J.H., Poppelaars, J., van der Horst, M., Broese van Groenou, M.I., Comijs, H.C., Pasman, H.R.W., van Schoor, N.M., Suanet, B., Thomése, F., van Tilburg, T.G., Visser, M., Huisman, M., 2016. The longitudinal aging study Amsterdam: cohort update 2016 and major findings. Eur. J. Epidemiol. 31 (9), 927–945.
Huisman, M.A., Poppelaars, J.L., Van der Horst, M.H.L., Beekman, A.T.F., Brug, J., Van Tilburg, T.G., Deeg, D.J.H., 2011. Cohort profile: the longitudinal aging study Amsterdam. Int. J. Epidemiol. 40, 868–876.
Hussein, M., Egan, H., Mantzios, M., 2017. Mindful construal diaries: a less anxious, more mindful, and more self-compassionate method of eating. Sage Open 7 (2) (2158244017704685).
IBM Corporation, 2015. IBM SPSS Statistics for Windows, Version 23.0 (Released). IBM Corp, Armonk, NY.
Khalsa, S.S., Rudrauf, D., Tranel, D., 2009. Interoceptive awareness declines with age. Psychophysiology 46 (6), 1130–1136.
Khan, Z., Zadeh, Z.F., 2014. Mindful eating and its relationship with mental well-being. Procedia Soc. Behav. Sci. 159, 69–73.
Kristeller, J., Wolever, R.Q., Sheets, V., 2014. Mindfulness-based eating awareness training (MB-EAT) for binge eating: a randomized clinical trial. Mindfulness 5 (3), 282–297.
Lamers, F., de Jonge, P., Nolen, W.A., Smit, J.H., Zitman, F.G., Beekman, A.T., Penninx, B.W., 2010. Identifying depressive subtypes in a large cohort study: results from the Netherlands Study of depression and anxiety (NESDA). J. Clin. Psychol. 71 (12), 1582–1589.
Lasserre, A.M., Glaus, J., Vandeleur, C.L., Marques-Vidal, P., Vaucher, J., Bastardot, F., Waeber, G., Vollenweider, P., Preisig, M., 2014. Depression with atypical features and increase in obesity, body mass index, waist circumference, and fat mass: a prospective, population-based study. JAMA Psychiatry 71 (8), 880–888. http://dx.doi.org/10.1001/jamapsychiatry.2014.411.
Levitan, R.D., Davis, C., Kaplan, A.S., Arenovich, T., Phillips, D.I.W., Ravindran, A.V., 2012. Obesity comorbidity in unipolar major depressive disorder: refining the core phenotype. J. Clin. Psychiatry 73 (8), 1119–1124.
Mantzios, M., Wilson, J.C., 2014. Making concrete construals mindful: a novel approach for developing mindfulness and self-compassion to assist weight loss. Psychol. Health 29 (4), 422–441.
Mantzios, M., Wilson, J.C., 2015. Mindfulness, eating behaviours, and obesity: a review and reflection on current findings. Curr. Obes. Rep. 4 (1), 141–146.
Mathers, C.D., Loncar, D., 2006. Projections of global mortality and burden of disease from 2002 to 2030. PLoS Med. 3 (11), 442.
Meier, B.P., Noll, S.W., Molokwu, O.J., 2017. The sweet life: the effect of mindful chocolate consumption on mood. Appetite 108, 21–27.
Milaneschi, Y., Lamers, F., Peyrot, W.J., Abdellaoui, A., Willemsen, G., Hottenga, J.J., Penninx, B.W., 2016. Polygenic dissection of major depression clinical heterogeneity. Mol. Psychiatry 21 (4), 516–522. http://dx.doi.org/10.1038/mp.2015.86.
Morley, J.E., 2012. Anorexia of aging: a true geriatric syndrome. J. Nutr. Health Aging 16 (5), 422–425.
Morley, J.E., 2013. Pathophysiology of the anorexia of aging. Curr. Opin. Clin. Nutr. Metab. Care 16 (1), 27–32.
NEVO, 2011. NEVO-table 2011. Stichting NEVO (Nederlands Voedingsstoffenbestand), Zeist.
Ohayon, M.M., Roberts, L.W., 2015. Challenging the validity of the association between oversleeping and overeating in atypical depression. J. Psychosom. Res. 78 (1), 52–57.
Papies, E.K., Barsalou, L.W., Custers, R., 2012. Mindful attention prevents mindless impulses. Soc. Psychol. Personal. Sci. 3 (3), 291–299.
Penninx, B.W.J.H., Beekman, A.T.F., Smit, J.H., Zitman, F.G., Nolen, W.A., Spinhoven, P., Cuijpers, P., de Jong, P.J., Van Marwijk, H.W.J., Assendelft, W.J.J., van der Meer, K., Verhaak, P., Wensing, M., de Graaf, R., Hoogendijk, W.J., Ormel, J., Van Dyck, R., 2008. The Netherlands Study of Depression and Anxiety (NESDA): rationale, objectives and methods. Int. J. Methods Psychiatr. Res. 17 (3), 121–140.
Quirk, S.E., Williams, L.J., O'Neil, A., Pasco, J.A., Jacka, F.N., Housden, S., Berk, M., Brennan, S.L., 2013. The association between diet quality, dietary patterns and depression in adults: a systematic review. BMC Psychiatry 13, 175.
Radloff, L.S., 1977. The CES-D scale: a self-report depression scale for research in the general population. Appl. Psychol. Meas. 1 (3), 385–401.
Rahe, C., Baune, B.T., Unrath, M., Arolt, V., Wellmann, J., Wersching, H., Berger, K., 2015. Associations between depression subtypes, depression severity and diet quality: cross-sectional findings from the BiDirect Study. BMC Psychiatry 15, 38–46. http://dx.doi.org/10.1186/s12888-015-0426-9.
Ruiz-Grosso, P., de Mola, C.L., Vega-Dienstmaier, J.M., Arevalo, J.M., Chavez, K., Vilela, A., Lazo, M., Huapaya, J., 2012. Validation of the Spanish center for epidemiological studies depression and Zung Self-Rating Depression Scales: a comparative validation study. PLoS One 7 (10), e45413.
Safran, J., Segal, Z.V., 1996. Interpersonal Process in Cognitive Therapy. Jason Aronson Incorporated, Northvale, NJ.
Sarris, J., Logan, A.C., Akbaraly, T.N., Amminger, G.P., Balanzá-Martinez, V., Freeman, M.P., Hibbeln, J., Matsuoka, Y., Mischoulon, D., Mizoue, T., Nanri, A., Nishi, D., Ramsey, D., Rucklidge, J.J., Sanchez-Villegas, A., Scholey, A., Su, K.-P., Jacka, F.N., 2015. Nutritional medicine as mainstream in psychiatry. Lancet Psychiatry 2 (3), 271–274.
Shapiro, S.L., Oman, D., Thoresen, C.E., Plante, T.G., Flinders, T., 2008. Cultivating mindfulness: effects on well-being. J. Clin. Psychol. 64 (7), 840–862.
Stel, V.S., Smit, J.H., Pluijm, S.M., Visser, M., Deeg, D.J., Lips, P., 2004. Comparison of the LASA physical activiy questionnaire with a 7-day diary and pedometer. J. Clin. Epidemiol. 57, 252–258.
van Strien, T., Winkens, L.H.H., Toft, M.B., Pedersen, S., Brouwer, I.A., Visser, M., Lähteenmäki, L., 2016. The mediation effect of emotional eating between depression and body mass index in the two European countries Denmark and Spain. Appetite 105, 500–508.
Tylka, T.L., Kroon Van Diest, A.M., 2013. The Intuitive Eating Scale–2: item refinement and psychometric evaluation with college women and men. J. Couns. Psychol. 60 (1), 137.
Winkens, L.H.H., van Strien, T., Barrada, J.R., Brouwer, I.A., Penninx, B.W.J.H., Visser, M., unpublished results. The Mindful Eating Behaviour Scale: Development and psychometric properties.
World Health Organization, 2012. Depression (Fact sheet No. 369). WHO, Geneva (Retrieved from). 〈http://www.who.int/mediacentre/factsheets/fs369/en/index.html〉.